

CLAIMS

What is claimed is:

- 1 1. A method, comprising:
 - 2 determining a new enqueue slot of a circular queue having N slots into which a
 - 3 queue element may be enqueued;
 - 4 determining whether the circular queue is full via executing a check comparing
 - 5 relative positions of the new enqueue slot and a current dequeue slot ("CDS"); and
 - 6 enqueueing the queue element into the new enqueue slot, if the circular queue is
 - 7 not full.

- 1 2. The method of claim 1 wherein determining whether the circular queue is full
 - 2 via executing the check comprises determining whether enqueueing the queue element
 - 3 into the new enqueue slot would result in an overflow condition of the circular queue via
 - 4 executing the check.

- 1 3. The method of claim 2, further comprising:
 - 2 setting a last enqueue slot ("LES") pointer currently designating an old enqueue
 - 3 slot to designate the new enqueue slot after determining the new enqueue slot;
 - 4 dropping the enqueue element, if the overflow condition would result from
 - 5 enqueueing the queue element into the new enqueue slot; and
 - 6 resetting the LES pointer to designate the old enqueue slot, if the overflow
 - 7 condition would result from enqueueing the queue element.

1 4. The method of claim 3, wherein executing the check further comprises
2 determining whether the following relation is true:

$$3 \qquad ((CDS^N - LES^N) \bmod N) < M,$$

4 wherein CDS^N represents $CDS \bmod N$, LES^N represents $LES \bmod N$, and M
5 represents a number less than N.

1 5. The method of claim 4 wherein M is equal to or greater than a maximum
2 number of slots that may be enqueued with queue elements during a delay period for
3 updating a dequeue counter.

6. The method of claim 1 wherein determining the new enqueue slot of the circular queue into which the queue element may be enqueued comprises determining the new enqueue slot according to a pre-sort deficit round robin enqueueing scheme.

7. The method of claim 2 wherein each of the N slots of the circular queue can buffer multiple queue elements corresponding to multiple logical queues, wherein the queue element corresponds to a particular one of the multiple logical queues, and wherein the new enqueue slot corresponds to the particular one of the multiple logical queues.

1 8. The method of claim 7 wherein determining whether the circular queue is full
2 comprises determining whether enqueueing the queue element into the new enqueue slot

3 of the circular queue would result in an overflow condition of the particular one of the
4 multiple logical queues.

1 9. A method, comprising:
2 dequeuing a queue element from a current dequeue slot (“CDS”) of a circular
3 queue having N slots;
4 designating a new CDS;
5 determining whether the circular queue is empty via executing a first check
6 comparing relative positions of the new CDS and a last enqueued slot (“LES”); and
7 setting the LES to the new CDS, if the circular queue is determined to be empty.

1 10. The method of claim 9 wherein the CDS is designated by a CDS pointer,
2 wherein designating the new CDS comprises incrementing the CDS pointer to designate
3 the new CDS, wherein the LES is designated by a LES pointer, and wherein setting the
4 LES to the new CDS comprises setting the LES pointer to designate the new CDS, if the
5 circular queue is determined to be empty.

1 11. The method of claim 9 wherein determining whether the circular queue is
2 empty further comprises executing a second check prior to executing the first check, the
3 second check comprising:
4 determining whether an enqueue count is equal to a dequeue count.

1 12. The method of claim 11, further comprising incrementing the dequeue count
2 after dequeuing the queue element from the CDS of the circular queue.

1 13. The method of claim 9 wherein executing the first check further comprises
2 determining whether the following relation is true:

3
$$((CDS^N - LES^N) \bmod N) < M$$

4 wherein CDS^N represents $CDS \bmod N$, LES^N represents $LES \bmod N$, and M
5 represents a number less than N .

1 14. The method of claim 9 wherein M is equal to or greater than a maximum
2 number of slots of the circular queue that may be enqueued with queue elements during a
3 delay period for updating a dequeue counter.

1 15. The method of claim 9 wherein each of the N slots of the circular queue can
2 buffer multiple queue elements corresponding to multiple logical queues, wherein the
3 queue element corresponds to a particular one of the multiple logical queues, and wherein
4 LES corresponds to the particular one of the multiple logical queues.

1 16. The method of claim 15 wherein determining whether the circular queue is
2 empty via executing the first check comprises determining whether the particular one of
3 the multiple logical queues is empty via executing the first check.

1 17. A machine-accessible medium that provides instructions that, if executed by a
2 machine, will cause the machine to perform operations comprising:
3 dequeuing a first queue element from a current dequeue slot (“CDS”) of a circular
4 queue having N slots, the CDS designated by a CDS pointer;
5 incrementing the CDS pointer to designate a new CDS; and
6 determining whether the circular queue is empty after the incrementing via
7 executing a first check comparing relative positions within the circular queue designated
8 by the CDS pointer and a last enqueued slot (“LES”) pointer.

1 18. The machine-accessible medium of claim 17, further providing instructions
2 that, if executed by the machine, will cause the machine to perform further operations,
3 comprising:
4 setting the LES pointer currently designating an old enqueue slot of the circular
5 queue to designate a new enqueue slot of the circular queue into which a second queue
6 element may be enqueued;
7 determining whether enqueueing the second queue element into the new enqueue
8 slot would result in an overflow condition of the circular queue via re-executing the first
9 check after setting the LES pointer to designate the new enqueue slot.

1 19. The machine-accessible medium of claim 18, further providing instructions
2 that, if executed by the machine, will cause the machine to perform further operations,
3 comprising:

4 enqueueing the second queue element into the new enqueue slot, if the overflow
5 condition would not result from enqueueing the second queue element into the new
6 enqueue slot;

7 dropping the second enqueue element, if the overflow condition would result from
8 enqueueing the second queue element into the new enqueue slot; and

9 resetting the LES pointer to designate the old enqueue slot, if the overflow
10 condition would result from enqueueing the second queue element into the new enqueue
11 slot.

1 20. The machine-accessible medium of claim 18, further providing instructions
2 that, if executed by the machine, will cause the machine to perform a further operation,
3 comprising determining the new enqueue slot of the circular queue into which the second
4 queue element may be enqueued.

1 21. The machine-accessible medium of claim 20, wherein determining the new
2 enqueue slot of the circular queue into which the second queue element may be enqueued
3 comprises determining the new enqueue slot according to a per-sort deficit round robin
4 queuing scheme.

1 22. The machine-accessible medium of claim 17, further providing instructions
2 that, if executed by the machine, will cause the machine to perform further operations,
3 comprising:

4 setting the LES pointer to designate the current dequeue slot, if the circular queue
5 is determined to be empty.

1 23. The machine-accessible medium of claim 22 wherein the determining
2 whether the circular queue is empty further comprises executing a second check prior to
3 executing the first check, the second check comprising:

4 determining whether an enqueue count is equal to a dequeue count, wherein the
5 enqueue count is incremented each time a queue element is enqueued and the dequeue
6 count is incremented each time a queue element is dequeued.

1 24. The machine-accessible medium of claim 18 wherein executing and re-
2 executing the first check comparing the relative positions within the circular queue
3 designated by the CDS pointer and the LES pointer comprises determining whether the
4 following relation is true:

$$5 \quad ((CDS^N - LES^N) \bmod N) < M$$

6 wherein CDS^N represents $CDS \bmod N$, LES^N represents $LES \bmod N$, and M
7 represents a number less than N.

1 25. The machine-accessible medium of claim 18 wherein each of the N slots of
2 the circular queue can buffer multiple queue elements corresponding to multiple logical
3 queues, and wherein the first queue element, the second queue element, and the LES
4 pointer correspond to a particular one of the multiple logical queues.

1 26. The machine-accessible medium of claim 25 wherein determining whether
2 the circular queue is empty comprises determining whether the particular one of the
3 logical queues is empty and wherein determining whether enqueueing the second queue
4 element would result in an overflow condition of the circular queue comprises
5 determining whether enqueueing the second queue element would result in an overflow
6 condition of the particular one of the logical queues.

1 27. A router system, comprising:
2 an input port to receive a first data unit from a first network link;
3 a circular queue having N slots to queue a first queue element;
4 a network processor communicatively coupled to the input port and the circular
5 queue, the network processor coupled to:
6 set a last enqueue slot ("LES") pointer to designate a new enqueue slot of
7 the N slots into which the first queue element may be enqueue; and
8 determine whether enqueueing the first queue element into the new
9 enqueue slot would result in an overflow condition of the circular queue via
10 executing a first check after setting the LES pointer, the first check comparing
11 relative positions within the circular queue designated by the LES pointer and
12 a current dequeue pointer ("CDS"); and
13 an output port communicatively coupled to the network processor to transmit the
14 first data unit to a second network link in response to dequeuing the first queue element
15 from the circular queue.

1 28. The router system of claim 27 wherein the network processor is further
2 coupled to:
3 enqueue the first queue element into the new enqueue slot, if the overflow
4 condition would not result from the enqueueing the first queue element into the new
5 enqueue slot;
6 drop the first data unit, if the overflow condition would result from enqueueing the
7 first queue element into the new enqueue slot; and
8 reset the LES pointer to designate a previous enqueue slot, if the overflow
9 condition would result from enqueueing the first queue element into the new enqueue slot.

1 29. The router system of claim 28 wherein the network processor is further
2 coupled to:
3 dequeue a second queue element from a CDS of the N slots designated by the
4 CDS pointer;
5 increment the CDS pointer to designate a new CDS; and
6 determine whether the circular queue is empty via re-executing the first check
7 after the increment of the CDS pointer.

1 30. The router system of claim 28 wherein the network processor is further to
2 determine whether the circular queue is empty via executing a second check prior to re-
3 executing the first check, the second check comprising:

4 determining whether an enqueue count is equal to a dequeue count, wherein the
5 network processor is to increment the enqueue count each time a queue element is
6 enqueued and to increment the dequeue count each time a queue element is dequeued.

1 31. The router system of claim 27 wherein executing the first check comparing
2 the relative positions within the circular queue designated by the CDS pointer and the
3 LES pointer comprises determining whether the following relation is true:

$$4 \quad ((CDS^N - LES^N) \bmod N) < M$$

5 wherein CDS^N represents $CDS \bmod N$, LES^N represents $LES \bmod N$, and M
6 represents a number less than N .

1 32. The router system of claim 27 wherein the first data unit comprises one of a
2 packet, a cell, and a frame.

1 33. The router system of claim 27 wherein the first queue element comprise a
2 pointer to a memory location containing the data unit.

1 34. The router system of claim 29 wherein each of the N slots of the circular
2 queue can buffer multiple queue elements corresponding to multiple logical queues and
3 wherein the first queue element, the second queue element, and the LES pointer
4 correspond to a particular one of the multiple logical queues.

1 35. The router system of claim 34 wherein determining whether the circular
2 queue is empty comprises determining whether the particular one of the logical queues is
3 empty and wherein determining whether enqueueing the first queue element would result
4 in an overflow condition of the circular queue comprises determining whether enqueueing
5 the first queue element would result in an overflow condition of the particular one of the
6 logical queues.